POLSKA AKADEMIA NAUK
ZAKŁAD ZOOLOGII SYSTEMATYCZNEJ

ACTA ZOOLOGICA CRACOVIENSIA

Tom XI Kraków, 31 VIII 1966 Nr 14

Zygmunt BOCHEŃSKI

Nesting of Common and Black Terns

[6 text-figs., plates XXXIV—XXXIX]

Gnieżdżenie się rybitwy pospolitej i czarnej

Гнездование речной и черной крачки

INTRODUCTION

On the basis of the data published by SOKOŁOWSKI (1958) and NOWAK (1965) most of the 9 species of terns nesting in Europe might be counted in the breeding avifauna of Poland. However, it seems that owing to the changes which have taken place in the distribution of some of these species in Europe within the last decades of years and against the general state of their present ranges, only 4 species nest within the boundaries of Poland. The Common Tern and the Black Tern nest comparatively frequently and numerously in suitable places, whereas the Little Tern is only rarely met with and no detailed data have been reported about the White-winged Tern in the recent years.

The present paper deals with the structure of nests of the two most numerous species from among those mentioned above. Its principal objective is to find out the adaptive possibilities of both these species and, in spite of the great variation in the structure of nests associated with these very possibilities of adaptation, the distinctive characters of the nests of these two species such as will make it possible to distinguish these nests from each other and from other similar nests.

MATERIAL

In this section either of the species is discussed separately. Both of them nest mostly in colonies and, consequently, the size, compactness and situation of a colony constitute a problem which must be considered separately from

other problems such as the situation, shape and measurements of a nest and the analysis of material used to build particular nests. Unfortunately, the data concerning some colonies are not complete (e.g. nest measurements are lacking) and for this reason the number of nests used in different analyses is variable.

Most of the material described in this paper was collected in Poland, but 4 colonies were observed out of this country. In the case of the Common Tern they were a mixed colony together with the Arctic Tern and the Little Tern in the Tensmuir Point Reserve in south-eastern Scotland and a colony in the Velký a Malý Tisý Reserve in southern Czechoslovakia, and as to the Black Tern, two small colonies on sodaic lakes near Sárszentágota in western Hungary. All the materials for this study were collected in 1958—1964.

Sterna hirundo hirundo LINNAEUS, 1758

The situation and size of colonies

1. Colony on the Vistula dam reservoir at Goczałkowice (Cieszyn Silesia); June 9, 1959. The colony was situated on an islet, 100 m long and 2—3 m wide, formed by the flooded old embankment of the Vistula. It is partly overgrown by grass and herbs and partly presents itself as bare patches of clay soil, in places covered with grit. I found 17 nests of terns on the islet. Most of them were placed on the bare ground, and only 3 lay in the grass or in its close vicinity. Besides the terns, there was a single nest of the Black-headed Gull *Larus ridibundus* there.

2. Mixed colony of Black-headed Gulls and Common Terns on Lake Świdwie * near Szczecin; June 7, 1960; referred to in my paper on the nesting of the Black-headed Gull (BOCHEŃSKI, 1962). It was situated on a small floating islet with a fairly hard but soaked substratum. Part of it was grown mostly by tufts of sweet flag, and part was formed by the remnants of water plants mown in the previous year. The colony consisted of about 30 nests of the Black-headed Gull and more than 10 nests of the Common Tern.

3. Mixed colony of Black-headed Gulls and Common Terns on the water reservoir at Goczałkowice; May 12, 1961. It was located on an islet, irregular in shape, near the mouth of the Stream Bajerka. The islet was entirely devoid of green vegetation (there were only some rhizomes of couch grass and dry sticks). The colony consisted of 18 nests of gulls and 3 nests of terns. It may be supposed that the number of terns' nests increased subsequently.

4. Mixed colony of Black-headed Gulls and Common Terns on the water reservoir at Goczałkowice; June 6, 1961. The colony was found on a flooded wood clearing near the southern shore of the lake. At a low water level large

* It is a newly established name of the lake known also as Lake Bolkowskie, which name I used in my paper on the nesting of the Black-headed Gull (Bocheński, 1962).

tracts of muddy ground were uncovered. They were only little elevated above the water surface and bristled with stumps, at intervals of a few metres, which had not been cleared. Higher situated places were covered with tufts of grass. The colony consisted of about 26 nests of terns and 40 nests of gulls.

5. Mixed colony of Common Terns, Arctic Terns *Sterna macrura* and Little Terns *S. albifrons* in the Tensmuir Point Reserve on the coast of the North Sea in south-eastern Scotland; June 25, 1962. It occupied a beach and a sand dune grown thinly with dune plants. The nests were placed at distances of a few metres from each other. The colony was spread widely and presumably composed of several hundred pairs of birds, among which Common Terns and Arctic Terns predominated and were more or less equal in number, whereas Little Terns were decidedly in the minority.

6. Colony on the Velký Tisý Pond in the Velký a Malý Tisý Reserve near Třeboň in southern Czechoslovakia; May 24, 1963. It was located on a small artificial islet, 15—20 m across and raised less than 1 m above water, which had been formed in the previous year, when the pond was drained. It was partly grown with grass. There were about 50 nests, most of them lying on the bare ground.

7. Water reservoir at Goczałkowice, June 22, 1963 and July 7, 1963. A mixed colony of Black-headed Gulls and Common Terns was situated on a small islet in the western part of the reservoir. The islet, about 40 m by 10 m, was partly covered with grass and herbs. In addition to about 30 nests of gulls and approximately the same number of terns there was 1 or 2 nests of ducks. Phenologically, the range of time in the breeding seasons of terns and gulls was conspicuous (up to 5 weeks).

8. Lake Kruklin; June-July 1958. A one-species colony of about 30 nests of Common Terns was observed on a muddy shore of the lake covered with stubs of reeds mown in the previous year. All the nests were built of reeds and lay near the water. (The data collected by B. Jabłoński).

9. Lake Kruklin; July 1958. A colony was situated near the previous one on floating patches of water vegetation differing in size and shape, far from the inshore zone of reeds. Four pairs of terns (besides, about 40 pairs of gulls and a few pairs of ducks) nested on the largest patch, up to 3·5 m in width, resembling a horseshoe in shape. On the other patches, tattered and from a few to dozens of metres apart, there were 16 pairs in all. (Data collected by B. Jabłoński).

10. Lake Kruklin; 1964. A loose colony, composed of 10 nests, was scattered on small islets, up to 1 m in diameter and slightly raised above the water surface, 1 or 2 nests on each. The nests were built of reed and always dry. (Data collected by B. Jabłoński).

11. A complex of fish-ponds at Gołysz (Cieszyn Silesia); July 1965. A single nest on a small islet, partly covered with grass, left after the reconstruction of pond and rising some dozens of centimetres above water. The nest lay on the bare dry ground, close to the water.

Nest-sites

The quantitative data concerning the particular nest-sites of the Common Tern are summarized in Table I. They have been obtained from the particular colonies in the following way: in most of the small colonies, numbering up to

Table I

Nest-sites of the Common Tern *Sterna hirundo* on the basis of the data from colonies 1—4, 6, 7, 9, 10 and 11

Type of site	On bare substratum or that overgrown with low vegetation	On floating coats and patches of vegetable material	By a tuft of grass or weeds	Surrounded by fairly high vegetation	Resting against a projection of ground, stone, tree stump, etc.	Total
Number of nests	45	30	3	2	3	83
%	54·2	36·1	3·6	2·4	3·6	99·9

somewhat more than ten nests, all the nests were analysed, whereas in the larger colonies the total number of nests was estimated and only a part of them analysed in detail. Only the data from the nests analysed in detail were used for tabulation. Sketches showing the position of nests belonging to the particular groups distinguished in Table 1 are given in Figure 1. It will be seen from this table that the largest number of nests were placed on the bare ground, sand or gravel, with a relatively flat surface, and among low plants which did not exceed several centimetres (Fig. 1A, B, C, D, E), without any inequalities of the surface in the form of high stones, stumps, and other similar objects that might have intercepted the view of the surroundings from the bird on the nest. Patches of floating water vegetation provided terns with similar conditions, which differed only in consistence of the substratum. The nests found on such patches come second in number. The nests protected by plants or a projection of the ground, more than several centimetres high, on one side (Fig. 1F, G, I, J) or on all sides (Fig. 1H), are in the minority. (Note: the vegetation surrounding the nests included in column 4 of Table 1 was low and, besides, it had probably grown up considerably for 3 weeks since the time of nest-building). Generally speaking, the tabulation of the data shows that the factor of visibility plays a much more important part in the choice of place for the nest than the structure of the substratum.

The distance of nests from the water undergoes great fluctuations, but there is a tendency for terns to nest as near the water as possible, often less

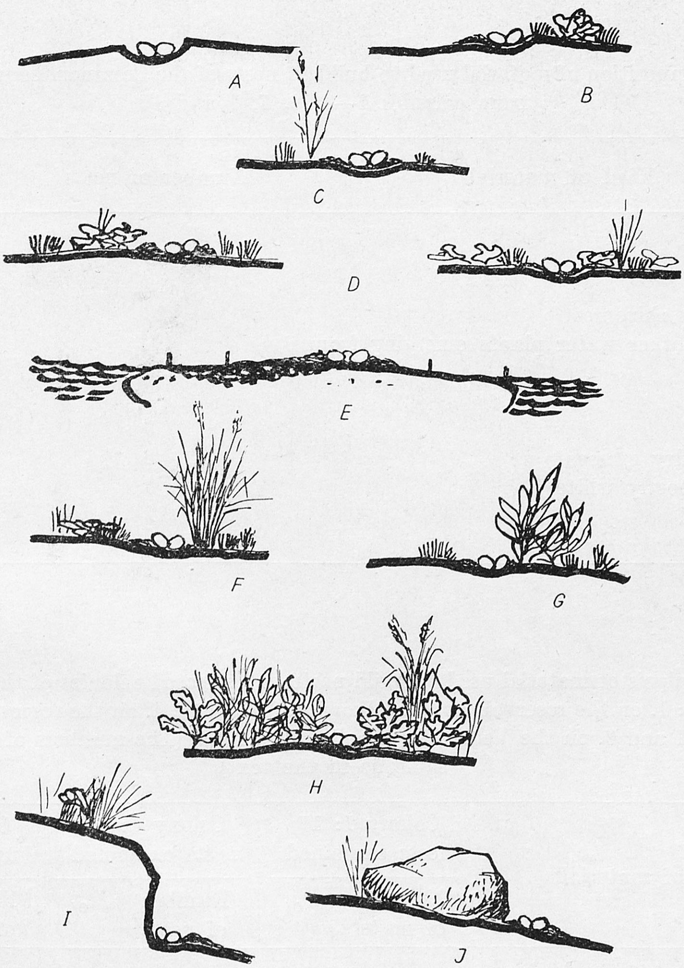


Fig. 1. Sketches of nests of the Common Tern *Sterna hirundo* in different colonies, showing their situation. A—D: on bare substratum and low vegetation, E: on floating coat of vegetable material, F, G: by a high fuft of grass or weeds, H: surrounded with high grass and weeds on all sides, I, J: protected by a projection of solid substratum.

than 1 m from it. Out of all the nests observed, those of the maritime ternery at Tensmuir Point in Scotland were situated farthest away from the water, which was undoubtedly connected with a wide range of high and low tide levels.

Nest material

The results of a qualitative analysis of the material used for the nests of the Common Tern are given in Table II. They show that sticks of various length and also stems and rhizomes of couch grass and other plants are the commonest material. Nevertheless, there is no generally characteristic material treated by these terns with special preference. A qualitative analysis of nest material

Table II

Qualitative composition of material used to build 82 nests of the Common Tern *Sterna hirundo*, from colonies 1—4, 6, 7, 9 and 10

Kind of material	Number of nests	%
Sticks	25	30·5
Roots	18	21·5
Couch grass rhizomes	22	26·8
Reeds and other water plants emerging from water	32	39·0
Tree bark	1	1·2
Stalks	3	3·6
Fresh and dry grasses	6	7·3
Feathers (mostly white)	8	9·7
No material	2	2·4

Table III

Qualitative analysis of material used to build nests in 3 selected colonies of the Common Tern *Sterna hirundo*: 1. on the reservoir at Goczałkowice, 9. 6. 1959, 4. on the reservoir at Goczałkowice, 6. 6. 1961 and 6. on the Velký Tisý Pond, 22. 5. 1963. (The numbers of colonies are the same as in the text)

Kind of material	Colony 1: 17 nests examined		Colony 4: 18 nests examined		Colony 6: 8 nests examined	
	Number of nests	%	Number of nests	%	Number of nests	%
Sticks	9	52·9	10	55·5	3	37·5
Roots	16	94·1	—		1	16·5
Couch grass rhizomes	—		18	100·0	—	
Reeds and other water plants emerging from water	—		—		1	16·5
Tree bark	—		1	5·5	—	
Stalks	—		—		3	37·5
Fresh and dry grasses	—		—		4	50·0
Feathers	1	5·8	7	38·8	—	
No material	—		—		1	16·5

in the particular colonies (Table III) indicates pronounced differences between them. On the other hand, the sorts of material occurring in particular colonies might be such as could be found in all or in most of the nests (in colony 1 roots were found in 16 out of the 17 nests examined and in colony 4 rhizomes of couch grass were present in all the 18 nests examined). This is undoubtedly connected

with the fact that the Common Tern collects material for the nest in its close vicinity, so the material occurring there in the largest quantity and, consequently, the easiest to obtain. Thus, the characteristic material of Common Terns' nests in particular colonies agrees with the predominant material available in the place of the colony. The greater variety of materials used in colony 6 comports with the diversity of materials available on the islet occupied by the colony. The occurrence of feathers in 7 nests of colony 4 points to some preference in choice of material. In most cases they were white feathers of Black-headed Gulls nesting in the same colony. Although in colonies of Black-headed Gulls there are always some feathers lying on the ground, their quantity, compared with the quantity of other materials that might have been used by terns to build their nests, is considerably smaller than might be judged from the number of the nests in which feathers were found.

Table IV

Amount of material used to build nests of the Common Terns *Sterna hirundo* and the resultant appearance of these nests. Data from colonies 1—4, 6, 7, and 10

Estimation of the amount of material used	A depression without any material	Eggs lying on bare substratum — a little material all round or on one side of the nest	Eggs lying on bare substratum or scanty lining — surrounded with a ring of material	Eggs lying on thick lining — nest is large and copious	Total
Number of nests	2	15	31	5	53
%	3·7	28·3	58·5	9·4	99·9

The amount of material used to build particular nests fluctuates remarkably, as will be seen from Table IV. In the extreme cases the eggs lie in a depression of the substratum (earth, gravel, sand, etc.) with no material gathered by birds round it or, on the other hand, large nests are built, in which the eggs lie on a thick bottom layer. There are many different intermediate types, which occur much more frequently than the extreme ones.

The shape and size of nests

On account of the great fluctuations of the amount of material used to construct nests and the differences in their position, the variation in size and general shape of nests is marked. The most primitive, though comparatively rare, type of nest is an unlined depression in the substratum, in which the eggs lie. One of the two nests of this type found during my field study (cf. Table IV) was in colony 6 on an islet in the Velký a Malý Tisý Reserve. It was a circular hollow in the clay soil, with no vegetation in its close neighbourhood (Phot. 3). The

diameter of the hollow was 13 cm and its depth 3 cm. The other nest for which the birds had not used any material was in colony 7 on an islet in the water reservoir at Goczałkowice. Here, however, it was a depression in the ground overgrown with the yarrow creeping over it, whose green leaves might partly substitute for lining. This depression was somewhat smaller than the previous one; its diameters measured crosswise were $11 \cdot 0 \times 11 \cdot 5$ cm and the depth was 1 cm. In the same colony there was another nest very similar to that described above. In this nest, besides leaves of the yarrow, there were live blades of grasses growing round the nest, bent down into it, which might be caused by the brooding bird. This nest is shown in Phot. 4.

The commonest type includes nests in which eggs lie on the bare, unlined substratum or on a very thin layer of lining of scanty fragments of nest material, surrounded by a circular wall of various size and shape built of nest material. Its size and shape depend on the sort of material used and the substratum on which the nest is placed. If stems and rhizomes of couch grass have been used to construct the wall, it is relatively narrow, if, however, it has been built of long sticks or stiff blades of water grasses, they project, sometimes even considerably, and the whole looks like a big and wide construction. An interesting modification of this type of nests is an incomplete semicircular wall, which occurs mostly in nests situated on a slightly sloping substratum, on their lower side. This fact indicates that the constructing of the wall, usually quite evident where the depression is slight or entirely wanting, is to prevent the eggs from rolling out of the nest. This is confirmed by the frequent presence of nests in which the surrounding ring of material brought by the bird is only "marked" with a small amount of material round the eggs. It is so for the most part where the depression in the substratum is pronounced or where other conditions of the substratum (e.g., tufts of plants growing round the nest) keep the eggs from rolling out. This also seems to be the reason why only a very small amount of material was used for nests in the colony on the beach at Tensmuir Point: it was very easy for the terns to make a depression in the sand, deep enough to keep the eggs in, much easier than in the hard clay soil, for instance, of the islets of the water reservoir at Goczałkowice or the Velký Tisý pond.

A separate, though not very numerously represented type comprises nests with a distinct and compact bottom layer, the thickness of which ranges from 0·5 to 2·0 cm (cf. Table IV). Nests of this type occur sporadically in different colonies and have not only the thickness of their bottom layer but also their outer and inner diameters larger than the average. Such nests are built on an entirely flat substratum, providing no depressions suitable for nests. One of the 5 nests of this type observed is presented in Phot. 8.

The measurements of the outer and inner diameters of Common Terns' nests are given in Figs. 2 and 3, which are scatter-diagrams showing the distribution of these two dimensions. Both the diameters were usually measured twice in each nest; it is especially important in the case of nests having a somewhat elliptical shape, where the largest and the smallest diameters were measured.

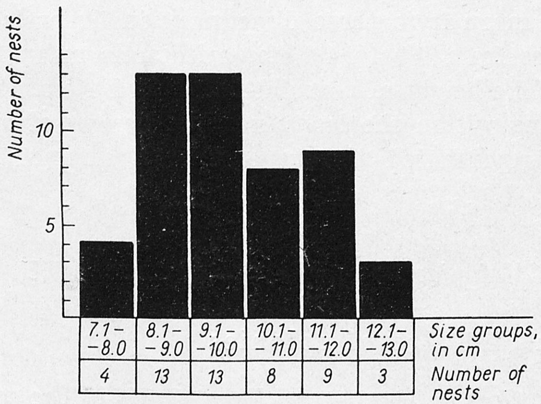


Fig. 2. Distribution of the mean diameters of the nest cup of the Common Tern *Sterna hirundo*. $\Sigma = 50$ nests.

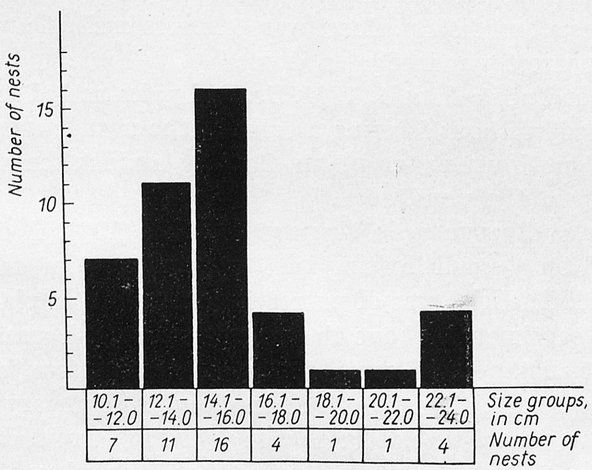


Fig. 3. Distribution of the mean outer diameters of 44 nests of the Common Tern *Sterna hirundo*.

The arithmetic means from these two measurements were used to construct the diagram. A total of 52 nests were measured; however, in some of the nests I failed to take all these measurements. For example, if a nest was nothing but a hollow in the substratum, with scanty lining on its bottom, the diameter of the hollow was regarded as the inner diameter of the nest, whereas the outer diameter was wanting. On the contrary, where the eggs lay on a small amount of material placed quite flat on an even substratum (without depressions), the extent of the material was treated as the outer diameter of the nest but, since it was impossible to determine the extent of the nest cup, the inner diameter was not measured. The measurements of the outer diameter (Fig. 3), taken in 44 nests, range from 11·5 cm (11·0 ×12·0 cm; 10·0 ×13·0 cm) to 24·0 cm (24·0 ×24·0 cm), the arithmetic mean from all these values being 15·37 cm. The inner diameter (Fig. 2) fluctuates between 8·0 cm (8·0 ×8·0 cm) and 13 cm (13·0 ×13·0 cm)

and the arithmetic mean from these dimensions in 50 nests is 10·06 cm. The depth of cup ranges from 0·0 to 4·0 cm (arithmetic mean from 52 measurements = 2·15 cm). The height of nest did not exceed 4 cm. It appears that out of the 6 nests falling within the last three size groups of outer diameters of nests (Fig. 3), 5 represented the type with a distinct and fairly thick bottom layer.

Chlidonias nigra nigra (LINNAEUS, 1758)

The situation and size of colonies

1. Fish-ponds at Gołysz; May 29 and June 18, 1959. The colony was situated on a small pond lying in the vicinity of other larger ones. About half the area of the pond was overgrown with plants. The nests were placed on a floating layer of mown water vegetation drifted by the wind against the growing water plants and forming a broad strip. There were 10 nests in all. They were 10 to 20 m away from the nearest pond edge (a dike).

2. Fish-pond at Zator; June 4, 1961. Several pairs nested loosely on a pond (1 nest was spotted) without forming a colony. The nest found was sited on an accumulation of cut-down water plants floating amidst the sparsely growing vegetation, far from the pond edge.

3. Fish-ponds at Raszyn near Warsaw; June 10, 1961. A colony of 10—12 nests was located on a small floating islet (approx. 3 ×5 m) far from the edge (dike) of the pond. The islet was of putrefying mown water plants; it projected for hardly a few centimetres above the water surface and was heavily soaked. The nests lay at distances of some dozens of centimetres from each other.

4. Sodaic lake near Sárszentágota, Transdanubia, Hungary; June 19, 1964. A small loose colony consisting of 2 nests on a shallow, grown densely over with *Bulboschoenus maritimus*. The nests were situated in places clear of plants, about 5 m in diameter, in which there were flat heaps of old mown vegetation.

5. Sodaic lake near Sárszentágota, Transdanubia, Hungary; June 23, 1964. (A few kilometres away from the colony described in item 4). Fourth-fifth of the lake area is grown over with *Bulboschoenus maritimus*. At the time of my observations the colony was just being set up. In one case an egg was deposited in the nest built on an old nest of the Coot and, besides, in some places the growing stems of *B. maritimus* were bent down and some old stems of this plant laid on them. They formed a loose "raft", floating on the water surface and defended by the terns. In addition, two other old (damaged) nests of coots or grebes were also defended by the terns. The number of pairs approximated to 10.

6. Fish-ponds at Zator; June 13, 1964. A loose colony consisted of a few nests, at intervals of 10 m or more, built on floating vegetable material on the border of the clear water and the area overgrown with plants, about 80 m from the edge of the pond (data collected by P. KUŚNIERCZYK).

7. Fish-ponds at Zator; June 13, 1964. On another pond than that in item 6 there was a colony of 16 nests on a patch of putrefying mown plants, about 30 m from the water edge, along the border of the low water vegetation. Intervals between the nests were up to several metres (data collected by P. Kuśnierczyk).

8. Fish-ponds at Stawno near Milicz; June 30, 1964. A loose colony of 52 nests on drifting swaths of reeds, manna-grass and scirpus *(Schoenoplectus)*. The nests were mostly built of material taken from floating swaths. They were 1—4 m apart (data collected by J. Witkowski).

9. Fish-ponds at Goczałkowice near Pszczyna; June 15 and July 5, 1965. A colony, estimated on the basis of the flying birds at about 20—30 pairs, was situated on loose floating vegetable material (mown reeds) accumulated by the wind on the edge of and in gaps amid the bed of manna-grass or on the bent-down stems of the growing manna-grass at various distances from the border of the pond.

10. Lake Świdwie near Szczecin; 1964. This lake is grown over heavily with plants and forms two smaller lakes, referred to as the lakes A and B. 1) On the lake A there was a one-species colony of about 50 pairs situated in an area grown with the water soldier *(Stratiotes alloides)* by the lake border overgrown with reeds. All the nests were sited on floating tufts of water soldier. 2) A one-species colony composed of about 150 pairs occupied a bed of water soldier far from the shore on the lake B. In the previous years Black Terns nested on this lake in similar conditions (data collected by J. Noskiewicz).

11. Lake Świdwie near Szczecin; 1965. On the lake B there was a mixed colony on a floating coat of vegetable material near the edge grown over with reeds. It consisted of about 600 nests of Blackheaded Gulls and about 150 nests of Black Terns, which were divided into two groups (about 100 and 50 nests respectively) situated on both sides of the portion of the coat occupied by the Black-headed Gulls. The nests of terns were in places where the coat was looser and formed for the most part of fragments of water soldier (data collected by J. Noskiewicz).

Nest-sites

All the nests of the Black Tern observed in the colonies described above were situated on reservoirs of stagnant water (lakes and ponds) and directly associated with water. A great majority of them were floating nests or those placed on different materials floating on the water surface, for instance, coats of putrefying vegetable remains, swaths of water plants, old nests of other water birds (e.g. Coot), etc. The nests on stiff heaps of water plants cut down in the previous year and lying on the bottom of shallows were very rare; there were only 2 such nests in colony 4 on the sodaic lake at Sárszentágota, but even these were situated on the edge, close to the water. Besides, the nests on fairly large patches of floating swaths of reeds or coats of vegetable material were

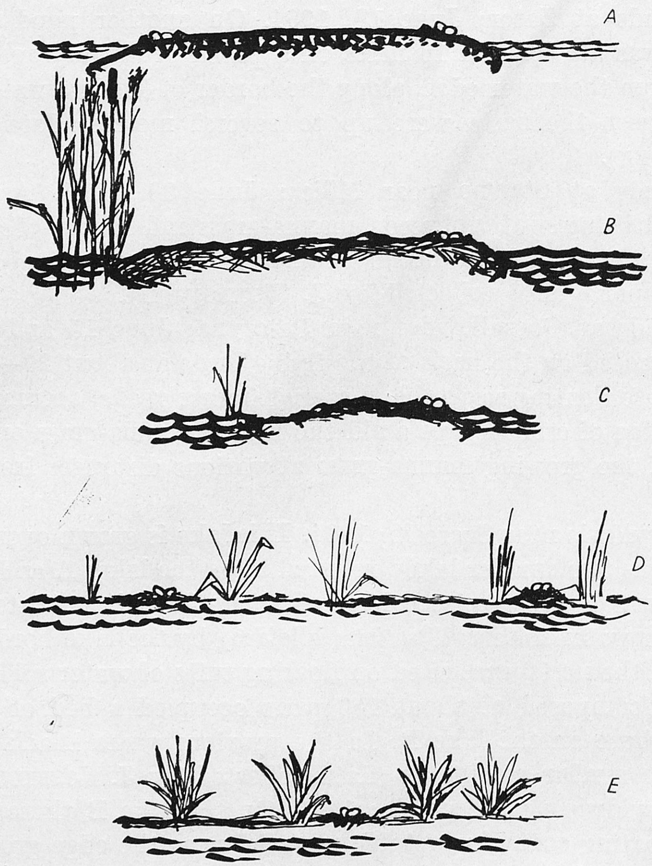


Fig. 4. Sketches of nests of the Black Tern *Chlidonias nigra* in different colonies, showing their situation. A: on fairly large coats of putrefied material, B: on floating swaths of reeds, C: on old nests of other water birds, D: among thinly growing plants on bent-down leaves and vegetable remains, E: in an area grown over with the water soldier.

for the most part grouped on their margins, near the water. Birds which did not find a relatively firm base in the form of an accumulation of floating fragments of plants to build their nests on, lay them down on a few bent-down stems or leaves of water plants, e.g., *Glyceria* or *Bulboschoenus maritimus*. The fact that this is, in a sense, a secondary or "substitutive" localization of nests is indicated by observations from colony 5 (sodaic lake at Sárszentágota), where the only nest containing one egg (the initial phase of egg-laying) was placed on an old massive floating nest of a Coot. Both the other old nests of water birds floating within the compass of the colony were also occupied by terns and the remaining terns built their nests on the bent-down stems of *Bulboschoenus*. These nests were still in the initial stage of construction. Another type of nest-sites was represented by the nests situated on patches of the growing water soldier *(Stratiotes alloides)*. Crossing runners of this plant form an

entangled net, which makes a strong base for building nests, a base which guarantees that even during a heavy wave the nests will not be destroyed.

The types of nest-sites discussed above have been presented schematically in Fig. 4. Unfortunately, the quantitative data could not be tabulated, because some of them are only estimates. However, it should be stated in general that there were no plants emerging from water in the close vicinity of the nests observed, or, if there were any, they were not high at the time when the colony was being laid down and the nests built (e.g., the water soldier, whose shrubs, however, grew up considerably during the incubation of eggs to assume the appearance of a thicket at the time of the hatching of the young. Cf. Phot. 10), or they grew sparsely *(Glyceria, Bulboschoenus)* and did not intercept the view from the brooding bird. The quantitative relation of the nests situated among sparsely growing plants emerging from water to the nests without such plants

Table V

Sites of nests of the Black Terns *Chlidonias nigra* in relation to their close vicinity on the basis of the data from colonies 1—8

Environment of nest	No plants emerging from water within a radius of 1 m	Sparse and low plants emerging from water within a radius of 1 m	Total
Number of nests	41	11	52
%	78·8	21·1	99·9

in their neighbourhood is given in Table V for 52 nests closely examined. The table shows that there were no plants projecting above the water surface in the close vicinity of nearly 80% of the nests, but this relation would probably change if all the nests from all the colonies were taken into account.

Nest material

The qualitative composition of the material used to build 45 nests of Black Terns is offered in Table VI. As can be seen from this table the greatest number of the nests (belonging, besides, to 3 different colonies) were built of vegetable remains from the previous year: reed, sweet flag, reed-mace, manna-grass, etc. This material was for the most part waterlogged and somewhat putrefied. Still green fragments of plants from the current year used for the nests of the group which was second in number were also putrefying and only rarely quite fresh. Completely rotten material was found to be the exclusive component of nests in only one colony (on a fish-pond at Raszyn, colony 3). It may be assumed in general that the nests in particular colonies do not differ from each other in building material. The occurrence of the smartweed and rush in single nests was sporadic and their pieces were an addition to a large quantity of fragments of reeds and other water plants found in all the nests of the colony. This qualita-

Table VI

Qualitative composition of material used to build 45 nests of the Black Tern *Chlidonias nigra* from colonies 1—8

Kind of material	Number of nests	%
Fresh and slightly putrefied leaves and stems of mown reed-grass, sweet flag, reed-mace, manna-grass etc.	16	35·5
Reeds mown in the previous year and floating on the water surface	22	48·8
Entirely putrefied vegetable material (specific composition difficult to determine)	4	8·8
Mown scirpus *Bulboschoenus maritimus*	3	6·6
Smartweed	1	2·2
Rush	1	2·2

Table VII

Wetness of nests of the Black Tern *Chlidonias nigra* on the basis of 45 nests from colonies 1—8

Degree of wetness of nest	Quite dry nests	Upper portion of nests dry, bottom wet	Whole nests are wet	Total
Number of nests	3	3	39	45
%	6·6	6·6	86·6	99·8

Table VIII

Measurements of temperature in 10 successive nests of Black Tern *Chlidonias nigra* in colony 1 on a fish-pond at Gołysz on 18. 6. 1959 (in °C). Air temperature: 24·3° C. Water temperature: 23·7° C

Ser. No of nest		1	2	3	4	5	6	7	8	9	10
Number of	eggs	3	1	3	3	2	1	3	—	1	3
	nestlings	—	1	—	—	1	1	—	2	—	—
Temperature under eggs		28·2	26·2	25·9	26·8	26·8	25·2	25·2	24·3	24·5	25·8
Temp. in the depth of bottom layer		26·2	25·9	25·6	25·4	25·6	25·5	25·0	24·8	24·9	25·4

tive uniformity of nest material in particular colonies was due to the location of nests in similar conditions and the use of nest material which was available in the closest vicinity of the nest, within reach of the beak, or simply to the modelling of material accumulated by the wind or waves into a desirable shape.

Most of the nests of Black Terns were evidently whole wet (saturated). The quantitative relations are given in Table VII, which shows that the nests of dry material were relatively few. The problem of thermal conductivity of the nest arises in connection with its humidity, for moist materials are far better conductors of heat than the dry ones and, in addition, they reduce the ambient temperature by absorbing heat during evaporation. Nevertheless, I managed to find that the temperature in the nests temporarily left by the brooding birds falls relatively slowly. The measurements of temperature taken in 10 nests of Black Terns in colony 1 on a fishpond at Gołysz on June 18, 1959 are given in Table 8. Two measurements of temperature were taken in each nest, immediately under the eggs and deeper, 2—4 cm under the bottom of the nest cup and thus beneath the surface of water. All the nests were sited on a loose coat of partly putrefying mown water plants and built of this very material (cf. Phot. 8). In one of the nests there were two newly hatched nestlings and in three others there was one nestling in each. Since none of the birds was brooding during my visit in the colony, and I took about 10 min. to measure each nest and its temperature, to take photographs, etc., the break in incubation increased with each successive nest and amounted to at least 100 min. for the last of them. None the less, the temperature under the eggs in the last nest was higher than the temperature of the air by 1·5°C and the temperature in the depth of the nest higher than the water temperature by 1·7°C. The smallest difference between the temperature of the water and that in the nest, measured deep under the bottom of the nest cup, was 1·1°C in the nest with two nestlings. The lowest temperature at the bottom of the nest cup was also found only in this cup and it equalled the air temperature. This is probably due to the fact that the adult birds, which may have been looking for food for the nestlings, had not incubated for a long time before my arrival in the colony. It may well be that the general slow drop in temperature in the depth of the nest is connected with the general accumulation of heat (among others from the solar radiation) in the floating coat of water plants and with the heat generated during putrefaction taking place in it.

The shape and size of nests

It is enough to compare the nests presented in Phots. 9—12, to see that they differ from each other rather considerably in size and shape. A close analysis of these photographs, however, shows that there is one basic model of nest building, and the differences in the final appearances of nests depend only on the properties of materials applied. This basic model of nest building consists in gathering material together round the place of the nest from the close vicinity

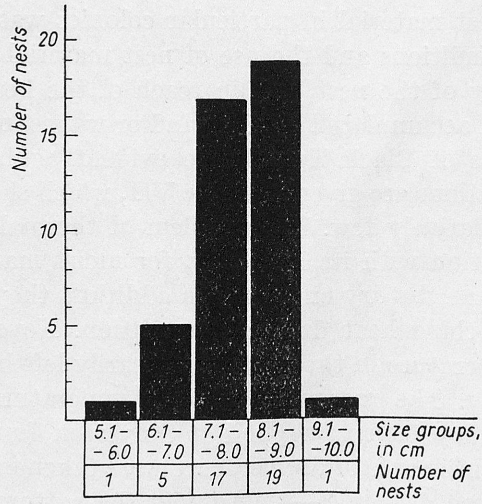


Fig. 5. Distribution of the mean diameters of the nest cup of 43 nests of the Black Tern *Chlidonias nigra*.

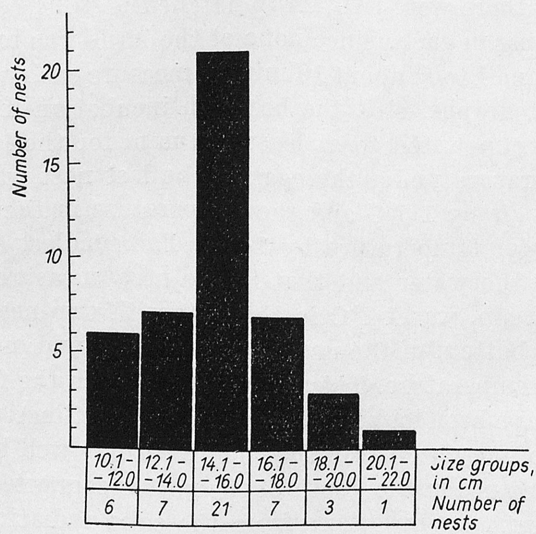


Fig. 6. Distribution of the mean outer diameters of 45 nests of the Black Tern *Chlidonias nigra*

and shaping it into a ring, up to 3 cm high. If the nest lies on a coat of completely putrefied vegetable material which forms a nearly homogeneous mass, its dimensions are small and its outer diameter fluctuates about 11 cm (e.g., in colony 3 on the ponds at Raszyn). The diameter of the nests placed on swaths of water plants is somewhat larger (about 15 cm), which is connected with the size of the fragments of stems and leaves of reeds, sweet-flag, etc. (cf. Phot. 9) gathered by the birds. The pieces of cut-down stems *(Bulboschoenus)*, up to 40 cm long, used for nests in colonies 4 and 5 (sodaic lakes near Sárszentágota), formed a fairly large and loose "crown" round each nest (Phots. 11 and 12).

For statistical calculations and diagrams I used, as for the nests of Common Terns, the arithmetic means from 2 measurements of the outer and inner diameters, which in the case of elliptical and irregular shapes of the nests were the smallest and largest measurements of the given dimension. Figure 5 shows the distribution of the arithmetic means of the inner diameter in the nests of Black Terns. The values of these means range from 6·0 cm (6·0 ×6·0) to 9·25 cm (9·0 ×9·5 cm). The average from 43 nests is 8·15 cm. The analogical distribution of the measurements of outer diameters in 45 nests measured is given in Fig. 6. The auter diameter value ranges between 11·0 cm (11·0 ×11·0 cm) and 21·0 cm (23·0 ×19·0 cm), the average being 15·15 cm. The measurements of the outer diameter did not include the loosely projecting stems forming the "crown". The depth of these 45 nests was from 0·5 cm to 3·0 cm, and the average amounted to 1·71 cm.

The loose structure of the nests and the properties of materials used (in many cases the lack of elasticity of particular components, e.g., partly putrefied leaves) bring about the occurrence of lasting deformations of the nest cup, which are exemplified, among other things, by the stretch of the cup. This is suggested by the measurements taken twice on the nests in colony 1 (on a pond at Gołysz). The measurements of 10 nests from this colony used for general calculations were made on June 18, 1959, in the final stage of incubation. In 2 nests the inner diameter of the nest cup was not measured, because I failed to determine it. The arithmetic mean from the measurements of the remaining 8 nests is 8·31 cm. Then it is larger than the general mean from all the nests examined. On May 19, in the initial stage of incubation, when there were no full clutches in any of the nests, the arithmetic mean of the inner diameters of the nest cups, calculated for 7 nests of the same colony (unfortunately, it is impossible to determine which of the 10 nests measured in June they were) was 6·86 cm and, therefore, smaller by nearly 1·5 cm. However, it should be emphasized that the smallest inner diameter of this series of measurements was 6·0 cm and thus it was equal to the smallest value in the general series of measurements. Finally, the relatively wide range between the smallest and the largest measurements of the inner diameter of the nest-cup (cf. Fig. 5) may be related, among other things, with the fact that the material used for study was not uniform in respect of advancement of incubation.

COMMENTS ON RESULTS

Sterna hirundo

The colonies of Common Terns discussed in this paper consisted of from a few to a few hundred pairs. Besides, in one case I found a single nest on a small islet. Though solitary nesting is a rare occurrence in this colonial species, some instances have already been recorded before (CAMPBELL, 1953; DYK, 1960). According to WITHERBY et al. (1941) a colony may sometimes reach a very

large size. The largest English colonies mentioned by BANNERMAN (1962) numbered 1200 and 1140 nests (Scolt Head Isl. and Blakeney Point, respectively). However, it may be assumed that a great majority of colonies range from some dozen to a few hundred pairs. The colonies in which Common Terns nest may include one or more species. The bird which accompanies them in Poland most frequently is the Black-headed Gull *Larus ridibundus*. Different species of ducks also often nest in small numbers within colonies of Common Terns or in their close neighbourhood, which according to KOSKIMIES (1957) is connected with better conditions they find here for their young to survive. There are also colonies mixed with other species of terns of the genus *Sterna* (e.g., the colony at Tensmuir Point described in this paper), and the nesting of a Black Tern within a colony of Common Terns is a known fact (JÓZEFIK, SWIRSKI, 1961). The situation of the colonies under study agrees with the data from literature (BANNERMAN, 1962; BORODULINA, 1963b; CAMPBELL, 1953; DUNAJEWSKI, 1938; JONES, 1906; SOKOŁOWSKI, 1958, and others). These authors also write that Common Terns show a tendency to build their nests in open places. JONES (1906) explains this fact by the requirement of perfect visibility from the nest place, whereas PALMER (1941) relates it with the way in which the bird approaches the nest and this is in turn connected with the length of bird wings and that of leap, for, as can be seen from PALMER's observations (o. c.), Common Terns land in open places and come up to their nests on foot, in contradistinction to short-legged and long-winged Arctic Terns, which alight directly on the nest. A small number of nests founded, even though on one side only, on inequalities of the substratum or tufts of plants (cf. Table I), which do not block the approach to the nest from the other sides but intercept the view from the nest, seems to indicate that the choice of place is governed, above all, by the maximum visibility attainable from the nest-site. In addition to the nest-sites, described in this paper, on the bare ground or the ground overgrown mainly by sparse and low vegetation, on gravel, sand-banks and dunes as well as on floating coats of vegetable material, there occur nests lying on floating pieces of trunks, planks, etc. (VESPREMEANU, 1964). Besides, WIKTOR (1957) has described a colony sited on the reinforced concrete deck of a wrecked tanker formed a sort of rocky islet covered with gravel. The qualitative composition of the material used to build nests varies considerably with the situation of colonies and depends on what the birds can find in their close vicinity (cf. Table III). Thus, for example, VESPREMEANU (1964) mentions stems of the water-chestnut *(Trapa natans)* as especially often used in the region of the River Danube and they were not represented in the colonies described in this paper at all. Out of the materials which were not found in the nests being analysed — they were not even represented by any similar materials — (cf. Table II), I must mention pebbles recorded by American authors (BENT, 1921; PALMER, 1941) and shells of mollusks (BENNERMAN, 1962). According to different authors, the amount of material used for building nests was very various. JONES (1906), for instance, writes that he did not find a nest without nest material. Neither did ANDERSEN (1959),

as can be seen from his tabulations. Unlike these authors, BORODULINA (1953b) claims that the percentage of nests without lining is different in different colonies (in some colonies all the nests are without lining). BENT (1921) holds a similar opinion in this respect. An analysis of the amounts of material used to build the nests examined in the present study (cf. Table IV) shows that these colonies have an intermediate position between the colonies described from south-eastern Europe (Crimea and the delta of the River Volga — BORODULINA, 1953b) and those from central Europe (Denmark — ANDERSEN, 1959), for there are remarkably fewer nests without material in them (only nearly 4%) than reported by BORODULINA (o. c.), but the number of nests with a large amount of material and a distinct bottom layer is also small. In BORODULINA'S (1953b) opinion, the amount of lining in nests depends on the wetness of the substratum: the damper the substratum, the larger is the amount of lining. On the other hand, PALMER (1941) found that the birds which nest late in the season, after the loss of the first clutch, have well-built second nests, and he tries to explain this by psychophysiological factors. At least 4 of the 5 most massively constructed nests of the present series (cf. Table IV, last column) were derived from different colonies, where they occurred among a large number of nests built of small amounts of material, in which the eggs lay on the bare substratum or scanty lining; therefore, it was not the greater wetness than in the neighbouring nests that caused the use of the larger amount of material. Neither the stage of advancement of incubation nor phenology indicated the fact that these nests had been constructed for the second time. So it seems that not only the two factors mentioned above determine the amount of material used by birds; other factors should indeed be sought among psychophysiological impulses, but those released by causes different from the destruction of the first nest. There are only few detailed data on the shape of nests in literature. Most of the authors write about a hollow lined with varying amounts of different materials, mostly of vegetable origin. Only PALMER (1941) discusses the diversity of appearances dependent on the amount of material and concludes that primitive nests are nothing but rings of nest material: sticks, leaves, stones, etc. The dimensions of nests are hardly ever given, excepting DEMENTIEV (1951), according to whom, the inner diameter of nests is usually 8—10 cm, and BORODULINA (1953b), who gives the following mean dimensions: for nests with material: outer diameter — 24 cm, inner diameter of cup — 11·5 cm, depth — 2·8 cm; for nests without material: diameter of hollow — 12·3 cm. A comparison of results shows that the data presented by DEMENTIEV (o. c.) coincide with only the lower half of the size groups of the inner diameter obtained during the present study (cf. Figs. 2 and 3). These groups, however, include a greater part of the nests. On the other hand, all the three means calculated by BORODULINA (1953b) for the nests with material are higher than those in the present series. Only the mean diameter of hollows without material approximates to the value of 12·17 cm obtained from two such nests described in this paper.

A comparison of my own material analysed in the previous section with the data from literature quoted above makes it possible to distinguish the following characteristics of the nesting of Common Terns: 1) The nest usually lies in a colony, which sometimes reaches many hundreds of pairs; cases of single nests are sporadic. 2) Most of the nests are situated on the ground, fewer on coats of vegetable matter floating on the water surface, but always in the vicinity of water; the nests placed on sandy beaches may be up to some dozens of metres away from water. 3) In most cases the nests are built on the bare substratum or amid low vegetation. 4) The nests are always built of dry material, the eggs for the most part lie on the bare substratum (soil, sand, etc.), surrounded with a ring of nest material, which varies in quantity. The ring is closed or open on one side only. 5) The outer diameter of the nest ranges from 10 to 23 cm and more, the inner diameter of the nest cup being 8—13 cm. 6) If the nest is a hollow without lining, its diameter fluctuates about 12 cm.

Chlidonias nigra

The number of pairs in Black Terns' colonies under study ranged between 2 and about 150: seven colonies had fewer than 20 pairs, 2 others 20—60 pairs and 2 more than 60 pairs (approx. 100 and 150). Nesting in small colonies, not exceeding 50 pairs and most frequently numbering from a few to some dozen pairs, is characteristic of this species, which is corroborated by the data of DEMENTIEV (1951) from Russia, HAVERSCHMIDT (1953) from Holland, BRINKMANN (1958) from Lower Saxony, and BORODULINA (1923 a), who, to be sure, mentions a colony of many thousands of pairs on Lake Mocishche in the Novosibirsk District, but this colony consisted of groups of 2—15 nests, situated tens or hundreds of metres apart. However rare it is, the nesting of single pairs together with the species of water and marsh birds has also been recorded (JÓZEFIK, SWIRSKI, 1961; ŠTĚPÁN, 1963). The small number of nests in most of the colonies, large distances often found between particular nests, and the ascertainment of the presence of pairs that nest singly, support the opinion of CUTHBERT (1964) that the Black Tern is only partly a colonial bird. It is also distinctive that Black Terns build their nests on dead vegetable remains floating on the water surface, on heaps of mown reeds and on growing water plants (DEMENTIEV, 1951; KARPOWICZ et al., 1958) and, as BORODULINA (1953 a) emphasizes, they are more closely associated with water than the other marsh terns of the genus *Chlidonias*. CUTHBERT (1954) also writes about their evident liking for space and low and sparse vegetation amidst a few feet of open water, which agrees with the data presented in Table V. In the face of the foregoing the description given by TURNER (1920) is almost surprising. He claims that among the nests observed by him there were no floating ones and even that at Texel Black Terns nested in meadows together with Lapwings and Redshanks and deposited their eggs in hollows dug in the earth and lined with

a small amount of vegetable material. The occasional occurrence of this type of nests is, however, confirmed by de MORSIER'S (1947, after CUTHBERT, 1954) observations from France. The use of old nests of other water birds (Coot) to build a new nest on, described in this paper, is a rare but not isolated phenomenon, as CUTHBERT (1954) observed a nest of the American subspecies of the Black Tern *Ch. nigra surinamensis* built on a nest of the American Coot *Fulica americana*. Similar cases in this subspecies are also described by BENT (1921), who, in addition, writes about exceptional instances of nests constructed on floating pieces of wood. Most of the nests are built with the material collected from the surface of water in the close vicinity of the nest, which also agrees with the data given by SCHUSTER (1926), BENT (1921) and CUTHBERT (1954); KNOX (1899) alone observed some flying Black Terns fetching material from rather long distances. The material for the nest constructed on the old nest of a Coot (cf. Phot. 12) must have been gathered in the same way, for the water surface was clear in the close neighbourhood. The measurements of Black Terns' nests offered by different authors (BORODULINA, 1953a; DEMENTIEV, 1951; SCHUSTER, 1926; ŠTĚPÁN, 1963), do not differ much from those given in this paper, only the size of the inner nest cup presented by DEMENTIEV (o. c.) is evidently smaller (5—6 cm). DEMENTIEV'S observations are contradictory with the arithmetic means calculated by BORODULINA (1953a), which are only slightly smaller than the data obtained during the present study (according to this authoress the arithmetic mean of the inner diameter amounts to 7·8 cm, and according to my calculations to 8·15 cm). Though the depth of the nest cup given by DEMENTIEV (2—2·5 cm) lies within the limits of fluctuations observed by me, it implies the considerably larger mean than those obtained by BORODULINA (1953a) and me (1·5 and 1·7 cm respectively).

On the basis of the analysis of the sites and structure of nests carried out in the previous section and the confrontation of my results with the data from literature it is possible to distinguish the following characteristic features of Black Terns' nests: 1) The nests occur in groups varying in size and are closely associated with water. 2) Most of the nests lie on floating vegetable remains drifted together by the wind or waves and on floating coats of growing plants, e.g., the water soldier. 3) In most cases, in the close vicinity of the nest there are no plants emerging above the surface of water, which might intercept the view from the brooding bird; if there are any plants round the nest, they are thinly scattered and low (note: such low and sparse plants in the initial stage of breeding may grow up considerably during incubation). 4) Most of the nests (above 90%) are built of wet material soaking in water, or at least their bottom portion is soaking. 5) The outer dimensions of the nests range from 10 to 22 cm (not including loosely projecting stems) in dependence on the kind of material used, the mean value being about 15 cm. The inner diameter of the nest cup is between 6 and 9 cm and this dimension approximates to the upper limit towards the end of incubation.

GENERAL

The nests from different colonies of both species of terns described in this paper vary considerably according to circumstances. This is due to the great adaptability of these birds as regards the choice both of a place for the nest and of nest material. The nest dimensions depend on the environment to a lower degree. This is particularly true of the inner diameter of the nest, which, according to PROMOTOV (1945) is regulated automatically, when the female moves round on the nest during its formation. It is therefore dependent, among other things, on the size of the bird, as has been shown by an example of the Spotted Flycatcher (BOCHEŃSKI, 1957). The fixity of the inner diameter of the nest depends on the elasticity of material, or on its great plasticity at the lack of elasticity, and for this reason the coefficient of variation of this dimension is different in different species. A comparison of the arithmetic mean ($\bar{X}$), the standard deviation (σ) and the coefficient of variation (V) calculated from the formula $V = \frac{\sigma}{\bar{X}} 100$ (ARKIN, COLTON, 1959) presented below illustrates these differences evidently. In addition to both the species of terns discussed in this paper, the comparison also includes the data concerning the Spotted Flycatcher, Black-necked Grebe and Black-headed Gull, partly quoted and partly calculated from the results published in other papers on the nesting of these species (BOCHEŃSKI, 1957, 1961, 1962):

Species	$\bar{X}$	σ	V
Muscicapa striata	6·0 cm	0·049	0·81
Larus ridibundus	14·78 cm	0·82	5·54
Podiceps nigricollis	11·15 cm	1·17	10·49
Chlidonias nigra	8·15 cm	0·736	9·03
Sterna hirundo	10·06 cm	1·343	13·35

The high coefficient of variation in the Black-necked Grebe is connected with the great plasticity of nest material and its lack of elasticity, which is reflected, among other things, in the correlation between the number of eggs and the size of the inner diameter of the nest (BOCHEŃSKI, 1961). The material used to build Black Terns' nests was nearly the same as in Black-necked Grebes in some of the colonies, in others, where the stems were not putrefied, it was stiffer. Therefore, though the fluctuations in the number of eggs are smaller, the loosely constructed nests of these birds are subject to stretch (cf. the section on the shape and size of nests of *Ch. nigra*), and hence the coefficient of variation is like that for the nests of the Black-necked Grebe. The inner diameter of the Common Tern's nest has the highest coefficient of variation of all the species compared. This presumably results, on the one hand, from the widest range of amounts of nest material used for building and the consequent differentiation of nests in respect of appearance, and, on the other hand, from the loose structure of the nest, which often (though not always) is built of non-elastic material

liable to lasting deformations. These three species may be set against the Spotted Flycatcher and Black-headed Gull, whose coefficient of variation of the inner diameter of nests is evidently lower. This is connected with the kind of material used and the structure of the nests.

As a matter of course, the more the coefficient of variation increases, the less characteristic the given dimension becomes. For this reason, when characterizing the nests of terns under study, I had to use not only their dimensions but also other data concerning their structure, material and site.

ACKNOWLEDGEMENTS

My heartfelt thanks are due to the following for their help in collecting materials for this work: Dr J. Berry (Edinburgh), Mgr Eng. J. Gotzman, Dr L. Horváth (Budapest), Dr B. Jabłoński, Mgr P. Kuśnierczyk, Dr J. D. Lockie (Edinburgh), Dr F. V. Mareš (Prague), Mr J. Noskiewicz, Mgr J. Wasilewski and Mgr J. Witkowski.

REFERENCES

Andersen, F. S. 1959. Bills, Eggs and Nests of Captured Arctic Terns (*Sterna paradisea* Pont.); and Common Terns (*Sterna hirundo* L.). Dansk Orn. For. Tidss. København. **53** (2): 81—102.

Arkin, H., Colton, R. R. 1959. Statistical Methods. New York.

Bannerman, D. A. 1962. The Birds of British Isles. London. **11**.

Bent, A. C. 1921. Life Histories of North American Gulls and Terns. Smithsonian Inst., U. S. Nat. Mus. Bull. Washington. **113**: 236—249, 290—299.

Birkmann, M. 1958. Das Vorkommen der Trauerseeschwalbe, *Chlidonias nigra*, im Emsland. Beitr. Naturk. Nieders. Hannover. **11** (2): 46—48.

Bocheński, Z. 1957. Obserwacje nad umiejscowieniem i budową gniazda u muchołówki szarej *Muscicapa striata* (Pall.). Zesz. Nauk. U. J. Zoologia. Kraków. **2**: 77—83.

— 1961. Nesting biology of the Black-necked Grebe. Bird Study. Oxford. **8** (1): 6—15.

— 1962. Nesting of Black-heaced Gull *Larus ridibundus* L. Acta zool. crac. Kraków. **7** (6): 87—120.

Borodulina, T. L. 1953a. K biołogii bołotnych kraczek. Trudy In-ta Morf. Żiw. im. A. N. Sewiercowa. Moskwa. **9**: 100—117.

— 1953b. Biołogija i rybochozjaistwiennoje znaczenije riecznoj kraczki. Trudy In-ta Morf. Żiw. im. A. N. Sewiercowa. Moskwa. **9**: 118—139.

Campbell, B. 1953. Finding Nests. London.

Cuthbert, N. L. 1954. A Nesting Study of the Black Tern in Michigan. The Auk. Lancaster. **71** (1): 36—63.

Dementiev, G. P. 1951. Otriad Czajki. (in: Pticy Sowietskogo Sojuza. Moskwa. **3**).

Dunajewski, A. 1938. Ptaki. (in: Fauna Słodkowodna Polski, Warszawa. **3**).

Dyk, V. 1960. Ostražitost rybáků. Živa. Praha. **8** (6): 237.

Haverschmidt, F. 1933. Gegevens over de verspreiding en de getals terkte van de broedkolonies van den Zwarten Stern (*Chlidonias n. niger* (L.)) in Nederland. Ardea. Leiden. **22** (3/4): 92—105.

Jones, L. 1906. A Contribution to the Life History of the Common (*Sterna hirundo*) and Roseate (*S. dougalli*) Terns. The Wilson Bull. Oberlin, Ohio. **18** (2): 35—47.

Józefik, M., Swirski, Z. 1961. Rzadsze gatunki *Laro-Limicolae* jeziora Kruklin (Pojezierze Mazurskie). Acta ornith. Warszawa. **6** (7): 72—82.

Karpowicz, W. N., Sołowiewa-Wołynskaja, T. N., Szecht, I. N. 1958. K ekołogii bołotnych kraczek pojmy sriedniego tieczenija rieki Oki. Trudy Okskogo Gos. Zap. Moskwa. **2**: 78—101.

Knox, J. C. 1899. My First Trip in '99. The Oologist. **16**: 118—120, 131—134.

Koskimies, J. 1957. Terns and Gulls as features of habitat recognition for birds nesting in their colonies. Ornis Fennica. Helsinki. **34** (1): 1—6.

Nowak, E. 1965. O konieczności i zakresie badań faunistycznych nad ptakami Polski. Przegl. zool. Wrocław. **9** (2): 168—178.

Palmer, R. S. 1941. A Behaviour Study of the Common Tern (*Sterna hirundo* L.). Proc. of the Boston Soc. of Nat. Hist. Boston, Mass. **42** (1): 1—119+2 charts + 1—14 plates.

Promptov, A. N. 1945. Fizjołogiczeskij analiz instinkta gniezdostrojenija u ptic. Izw. Akademii Nauk SSSR (ser. bioł.), Moskwa. **1**: 1—26.

Schuster, L. 1926. Zur Brutbiologie einiger märkischer Luchvögel. Beitr. zur Fortfpl. der Vögel. Berlin. **2** (3): 67—71.

Sokołowski, J. 1958. Ptaki Ziem Polskich. Warszawa. **2**.

Štěpán, J. 1963. Hnízdění rybáka černého na Hodoninsku. Živa. Praha. **11** (1): 34—35.

Turner, E. L. 1920. The Black Tern. British Birds. London. **14** (6): 122—126.

Vespremeanu, E. E. 1964. Zur Ökologie der Vögel des Überschwemmungsgebietes der Donau. Aquila. Budapest. **69—70**: 213—221.

Wiktor, J. 1957. Interesująca kolonia rybitwy pospolitej (*Sterna hirundo* L.) na Zalewie Szczecińskim. Przyr. Polski Zach. Poznań **1** (1—2): 114—120.

Witherby, H. F. et al. 1941. The Handbook of British Birds. London. **5**.

STRESZCZENIE

Autor omawia gnieżdżenie się rybitwy pospolitej *Sterna hirundo* i rybitwy czarnej *Chlidonias nigra* na podstawie danych, zebranych w większości na terenie Polski, a ponadto w Szkocji, Czechosłowacji i na Węgrzech, w latach 1958—1964. Dla każdego gatunku omawiane są po kolei: położenie i wielkość obserwowanych kolonii, usytuowanie poszczególnych gniazd, materiał do budowy gniazda oraz kształt i wielkość gniazd.

Na rys. 1 (str. 427) przedstawione jest szkicowo usytuowanie różnych gniazd rybitwy pospolitej. Mogą one leżeć na gołym podłożu (ziemi, piasku itp.) lub rzadko porosłym roślinnością (ryc. 1: A, B, C, D), na pływającym kożuchu (ryc. 1: E), w oparciu o kępę trawy lub chwastów (ryc. 1: F, G), otoczone zewsząd trawami lub chwastami (ryc. 1: H) względnie pod osłoną stałego występu podłoża (ryc. 1: I, J). Ilościowe zestawienie gniazd w zależności od ich położenia daje tabela I (str. 426): najczęstsze są gniazda położone na gołym, lub niewiele zarosłym podłożu oraz na pływających kożuchach. Najczęściej spotykanym w gniazdach materiałem są fragmenty trzcin i innych roślin wodnych wynurzonych, patyki i kłącza perzu (tabela II, str. 428). Skład materiału użytego do budowy gniazd w różnych koloniach jest różny (por. tabela III, str. 428). Wiąże się to z położeniem kolonii i możliwościami zdobycia materiału, który ptaki te zbierają w najbliższym otoczeniu gniazda. Ilość użytego do budowy gniazda materiału i związany z nią wygląd gniazda jest bardzo różny: od niczym nie

wyścielonego zagłębienia w ziemi po duże gniazdo (tabela IV, str. 429; fot. 3—7). Najliczniejsze jednak są gniazda, w których jaja leżą na gołym podłożu lub znikomej podściółce, a wokół nich znajduje się wyraźny, pierścieniowaty wał z gniazdowego materiału. Wymiary gniazd ulegają znacznym wahaniom: średnica wewnętrzna czaszy gniazda od 8 do 13 cm (średnia arytmetyczna dla 50 gniazd = 10,06 cm), średnica zewnętrzna gniazda od 11,5 do 24 cm (średnia dla 44 gniazd = 15,37 cm), głębokość od 0 do 4 cm (średnia dla 52 gniazd = 2,15 cm). Rozkłady ilościowe dwu pierwszych wielkości przedstawione są na wykresach: dla średnicy wewnętrznej ryc. 2 (str. 431) i dla średnicy zewnętrznej ryc. 3 (str. 431).

Schematy umiejscowienia gniazd w różnych koloniach rybitwy czarnej przedstawia ryc. 4 (str. 434). Gniazda mogą leżeć na pływających wysepkach-kożuchach (rys. 4: A), na pływających pokosach szuwarów (ryc. 4: B), na starych gniazdach innych ptaków wodnych (ryc. 4: C), na pływających resztkach roślinnych i pozałamywanych liściach w rzadkich połaciach roślin wynurzonych np. manny (ryc. 4: D) i na kożuchach utworzonych przez rosnącą osokę (ryc. 4: E). Większość gniazd nie miała wokół siebie w promieniu do 1 m roślin wynurzonych (tabela V, str. 435). Materiał użyty do budowy gniazd składa się z rozmaitych roślin wodnych, przy czym najwięcej gniazd zbudowanych było ze ściętych i pływających po powierzchni wody wokół gniazda fragmentów różnych zeszłorocznych roślin wynurzonych (tabela VI, str. 436). Znaczna większość gniazd (ponad 85%) zbudowana jest z mokrego materiału (tabela VII, str. 436). Mimo wilgotnego materiału, temperatura w gniazdach, z których wysiadujące ptaki zeszły, opada bardzo powoli. Wyniki pomiarów temperatury gniazdach przedstawia tabela VIII (str. 436). W każdym z gniazd temperatura była mierzona dwukrotnie: bezpośrednio pod jajami i głębiej pod powierzchnią dna (czyli poniżej poziomu wody w stawie). Przez cały czas pomiarów wszystkie ptaki z kolonii były w powietrzu. W ostatnim z kolei gnieździe spowodowało to przerwę w wysiadywaniu przynajmniej 1 godz. i 40 min. Mimo tej przerwy temperatura pod jajami była w tym gnieździe o 1,5° C wyższa od temperatury powietrza a temperatura w głębi warstwy dennej o 1,7° C wyższa od temperatury wody w stawie. Powolny spadek temperatury w głębi gniazda może się wiązać z ogólną akumulacją ciepła (m. in. słonecznego) przez pływający kożuch, na którym były położone gniazda, oraz z ciepłem wytwarzanym przy procesach gnilnych zachodzących w kożuchu. Fotografie 8—12 ilustrują znaczną zmienność wyglądu gniazd rybitwy czarnej. Duże wahania widać też w wymiarach (ryc. 5 i ryc. 6, str. 438). Średnica wewnętrzna gniazda waha się od 6,0 do 9,25 cm (średnia arytmetyczna dla 43 gniazd = 8,15 cm), średnica zewnętrzna od 11 do 21,0 cm (średnia dla 45 gniazd = 15,15 cm). Głębokości 45 gniazd wahały się od 0,5 do 3,0 cm, przy średniej 1,71 cm. Dwukrotne mierzenie tych samych gniazd na początku i końcu okresu wysiadywania wskazuje na rozciąganie się czaszy gniazda i wyraźne powiększanie się średnicy wewnętrznej.

W rozdziale poświęconym omówieniu wyników porównane są uzyskane w obecnym opracowaniu dane z wynikami innych autorów. Rezultatem tych

porównań są charakterystyki gnieżdżenia się obu gatunków rybitw. Na końcu porównane są wyniki obliczeń statystycznych, dotyczących średnicy wewnętrznej gniazda u badanych gatunków rybitw oraz innych gatunków badanych poprzednio przez autora (Bocheński, 1957, 1961, 1962). Okazuje się, że współczynnik zmienności średnic gniazd rybitw jest podobnie jak u perkoza zausznika wysoki, dzięki czemu ten wymiar nie jest tak charakterystyczny dla gniazd tych gatunków, jak to ma miejsce w przypadku muchołówki szarej i mewy śmieszki.

РЕЗЮМЕ

Автор рассматривает гнездование речной крачки *Sterna hirundo* и черной крачки *Chlidonias nigra* на основании данных, собранных преимущественно на территории Польши, а кроме того в Шотландии, Чехословакии и Венгрии, в годы 1958—1964. При рассмотрении кажого из этих видов учитываются: положение и величина наблюдаемых колоний, размещение отдельных гнезд, материал, используемый для постройки гнезда, а также форма и размеры гнезд.

На рис. 1 (стр. 427) показано схематично размещение разных типов гнезд речной крачки. Гнезда встречаются на голой поверхности почвы, песке и т. п., на почве, покрытой скудной растительностью (рис. 1: A, B, C, D), на плавающем слое растительных остатков (рис. 1: E), на кочке травы или сорняков (рис. 1: F, G), окруженные со всех сторон травами или сорняками (рис. 1: H) или под навесом почвы (рис. 1: I, J). Количественное сопоставление гнезд в зависимости от их местоположения содержится в таблице I (стр. 426): чаще всего встречаются гнезда, расположенные на голой или покрытой скудной растительностью поверхности почвы и на плавающем слое растительных остатков. Строительным материалом, встречаемым чаще всего в гнездах, являются остатки тростника и других водяных растений, возвышающихся над водой, ветки и корневища пырея (таблица II, стр. 428). Состав строительного материала, использованного в разных колониях, разен (ср. таблицу III, стр. 428). Это связано с местоположением колонии и возможностями найти материал, который птицы собирают вблизи от гнезда. Количество материала, использованного для постройки гнезд, и связанная с ним форма гнезд очень разнообразны: от ничем не покрытой ямы в почве по большое гнездо (таблица IV, стр. 429; фото 3—8). Самыми распространенными являются однако гнезда, в которых яйца лежат на голой почве или скудной подстилке, а кругом располагается перстеневидный вал из гнездового материала. Размеры гнезд колеблются значительно: внутренний диаметр чаши гнезда — от 8 до 13 см (арифметическая средняя диаметра внутренней чаши гнезда равна 10,06 см), внешний диаметр гнезда — от 11,5 до 24 см (средняя для 44 гнезд — 15,37 см), глубина — от 0 до 4 см (средняя для 52 гнезд = 2,15 см). Диаграммы распределения двух первых величин изображены на графиках: для внутреннего диаметра на рис. 2 (стр. 431) и для внешнего диаметра на рис. 3 (стр. 431).

Схемы размещения гнезд в разных колониях черной крачки показаны на рис. 4 (стр. 434). Гнезда могут лежать на плавающем островке — слое растительных остатков (рис. 4: A), на плавающих покосах камыша (рис. 4: B), на старых гнездах других водяных птиц (рис. 4: C), на плавающих растительных остатках и согнутых листьях на площадках, редко заросших растениями, возвышающимися над водой, например, манника (рис. 4:D), и на плавающих слоях, образованных растущей осокой (рис. 4: E).

В большинстве случаев вокруг гнезд в радиусе до 1 м отсутствовали растения, возвышающиеся над водой (таблица V, стр. 435). Материал, использованный для постройки гнезд, состоит из различных водяных растений, причем самое большое число гнезд построено из срезанных и плавающих на поверхности воды остатков разных прошлогодних растений, возвышающихся над водой (таблица VI, стр. 436). Значительное большинство гнезд (свыше 85%) построено из мокрого материала (таблица VII, стр. 436). Несмотря на влажность материала, температура в гнездах, временно покинутых насиживающими птицами, снижается очень медленно. Результаты измерений температуры в 10 гнездах указаны на таблице VIII (стр. 436). В каждом гнезде температура измерялась дважды: непосредственно под яйцами и глубже, под поверхностью днища (т. е. ниже уровня воды в пруду). Во время измерений все птицы колонии находились в воздухе. В результате замеры температуры в последнем гнезде были произведены после перерыва в насиживании, продолжавшегося не менее 1 ч. 40 мин. Несмотря на этот перерыв, температура под яйцами была на 1,5° выше температуры воздуха, а температура в глуби слоя днища на 1,7° выше температуры воды в пруду. Медленное снижение температуры в глуби гнезда, возможно, связано с общим накоплением тепла (между прочим и солнечного) плавающим слоем растительных остатков, на котором были расположены гнезда, а также с теплом, возникающим в результате процессов гниения, происходящих в слое растительных остатков. Фото 9—12 иллюстрируют значительное разнообразие формы гнезд черной крачки. Заметные колебания наблюдаются также в размерах гнезд (рис. 5 и рис. 6, стр. 438). Внутренний диаметр гнезд насчитывает от 6,0 до 9,25 см; арифметическая средняя для 43 гнезд равна 8,15 см. Внешний диаметр насчитывает от 11,0 до 21,0 см (средняя для 45 гнезд = 15,15 см). Глубина 45 гнезд колеблется от 0,5 см до 3,0 см; средняя = 1,71 см. Двухкратное измерение тех же самых гнезд в начале и в конце периода насиживания показывает расширение чаши гнезда и заметное увеличение внутреннего диаметра.

В главе, посвященной обсуждению итогов, сопоставляются данные, полученные в ходе исследований, с данными, достигнутыми другими авторами. На основании этих сопоставлений дана характеристика гнездования обоих видов крачки. В заключении дается сравнение статистических подсчетов, касающихся внутреннего диаметра гнезд наблюдаемых видов крачки и других видов, исследуемых автором ранее (Бохеньский, 1957, 1961, 1962). Оказывается, что коэффициент изменяемости диаметра гнезд у крачек высок, как и у черношейной поганки, в связи с чем данный показатель менее характерен для этих видов, чем для серой мухоловки и озерной чайки.

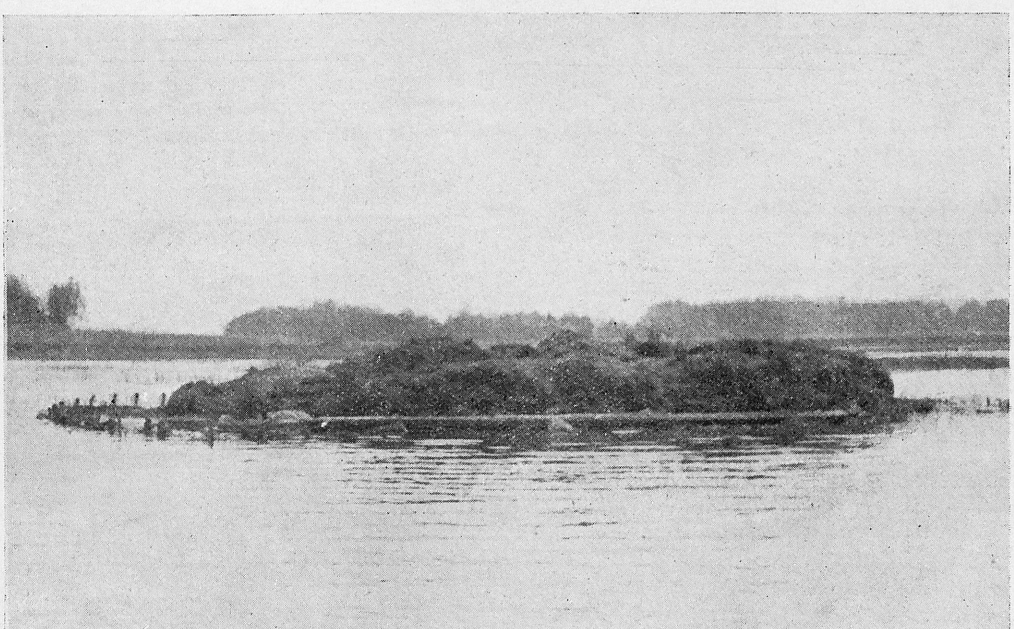
Plate XXXIV

Phot. 1. Situation of a colony of the Common Tern *Sterna hirundo* on the water reservoir at Goczałkowice in May 1961 (colony 3).

Phot. 2. An islet in the Velký Tisý Pond in Czechoslovakia, on which there was a colony of the Common Tern *Sterna hirundo* in May 1963 (colony 6).



Phot. 1



Phot. 2

Z. Bocheński
Phot. author

Plate XXXV

Phot. 3. A nest of the Common Tern *Sterna hirundo* in colony 6 on the Velký Tisý Pond — a hollow practically without nest material.

Phot. 4. A nest of the Common Tern *Sterna hirundo* belonging to colony 7 on an islet in the water reservoir at Goczałkowice in June 1963. It is sited among grasses and herbs and has only a slight amount of nest material.



Phot. 3



Phot. 4

Z. Bocheński
Phot. author

Plate XXXVI

Phot. 5. A nest of the Common Tern *Sterna hirundo* in a colony on the Velký Tisý Pond in May 1963. It represents the commonest type of nests with a small amount of material used for building a ring round the eggs.

Phot. 6. A nest of the Common Tern *Sterna hirundo* in a colony on the water reservoir at Goczałkowice in June 1961. It represents the type of nests with a large amount of material and a distinct bottom layer.



Phot. 5



Phot. 6

Z. Bocheński
Phot. author

Plate XXXVII

Phot. 7. A nest of the Common Tern *Sterna hirundo* in colony 4 on the water reservoir at Goczałkowice in June 1961. The nest material is shaped into an open ring protecting the nest from the side of the water, towards which the substratum is sloping slightly.

Phot. 8. A nest of the Black Tern *Chlidonias nigra* in colony 1 on a pond at Gołysz in June 1959. It is sited on a floating coat of mown reeds.



Phot. 7



Phot. 8

Z. Bocheński
Phot. author

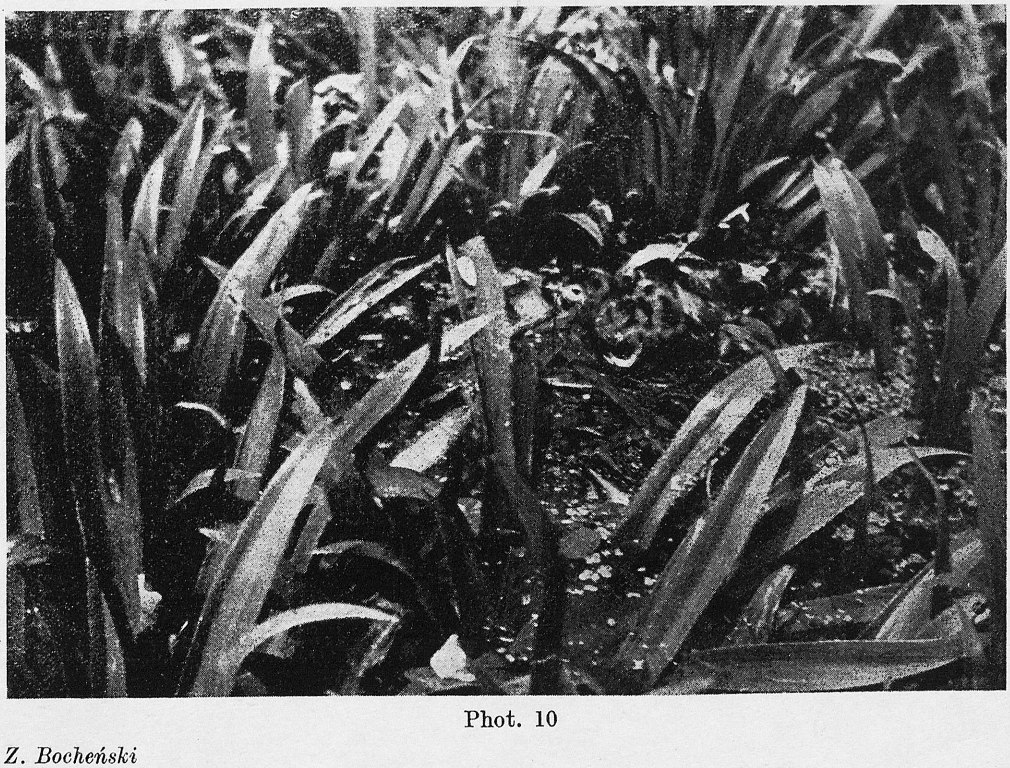
Plate XXXVIII

Phot. 9. A nest of the Black Tern *Chlidonias nigra* in colony 2 on a pond at Zator in June 1961. The nest is placed on a floating coat of putrefying vegetable remains among thinly growing plants.

Phot. 10. The environment and nest-site of a Black Tern *Chlidonias nigra* in a bed of water soldier on Lake Świdwie near Szczecin. At the nest-site there is a nestling.



Phot. 9



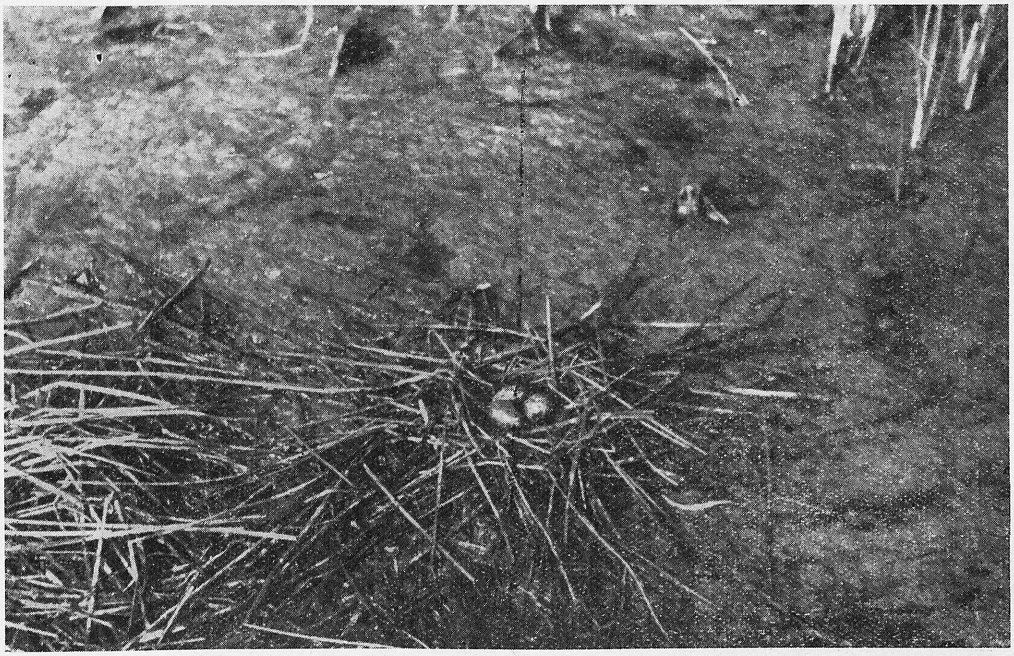
Phot. 10

Z. Bocheński
Phot. 9 — author, phot. 10 — J. Noskiewicz

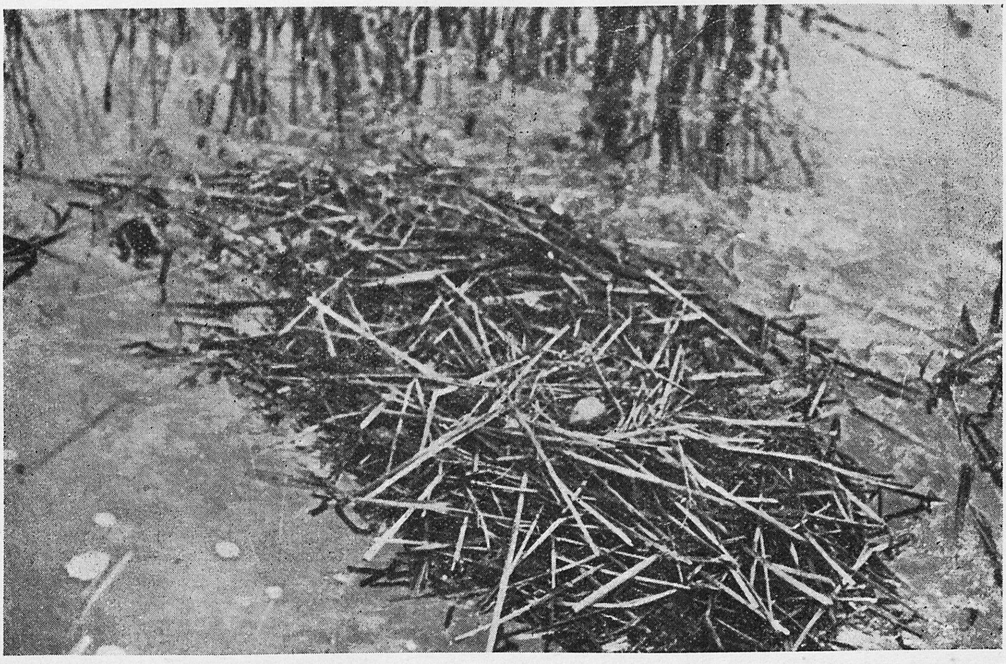
Plate XXXIX

Phot. 11. A nest of the Black Tern *Chlidonias nigra* in colony 4 on a sodaic lake near Sárszentágota in Hungary in June 1964. The nest is sited at the margin of a heap of plants mown in the previous year.

Phot. 12. A nest of the Black Tern *Chlidonias nigra* in colony 5 on a sodaic lake near Sárszentágota in Hungary in June 1964. It is built on an old nest of the Coot.



Phot. 11



Phot. 12

Z. Bocheński
Phot. author

Redaktor zeszytu: prof. dr K. Kowalski

PAŃSTWOWE WYDAWNICTWO NAUKOWE — ODDZIAŁ W KRAKOWIE — 1966

Nakład 800+100 egz. — Ark. wyd. 2,75 — Ark. druk. $2^{8}/_{16}$ — Papier ilustr. kl. III 80 g 70×100
Zam. 332/66 Cena zł 12,—

DRUKARNIA UNIWERSYTETU JAGIELLOŃSKIEGO W KRAKOWIE